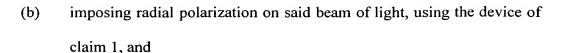
## WHAT IS CLAIMED IS:

- 1. An optical device, for manipulating incident light of at most a certain maximum wavelength, comprising:
  - (a) a substantially planar grating including a plurality of electrically conducting stripes and having a space-variant, continuous grating vector, at least a portion of said grating having a local period less than the maximum wavelength of the incident light.
- 2. The device of claim 1, wherein a magnitude of said grating vector varies laterally and continuously.
- 3. The device of claim 1, wherein a direction of said grating vector varies laterally and continuously.
  - 4. The device of claim 1, wherein said grating vector is periodic.
  - 5. The device of claim 4, wherein said grating is translationally periodic.
  - 6. The device of claim 4, wherein said grating is rotationally periodic.
  - 7. The device of claim 1, wherein said stripes include a metal.
  - 8 The device of claim 1, further comprising:
  - (b) a substrate supporting said stripes.

- 9 The device of claim 8 wherein said substrate includes a material selected from the group consisting of gallium arsenide, zinc selenide, quartz and silica glass.
- 10. The device of claim 1, wherein said grating is operative to pass laterally uniform, polarized incident light with a predetermined, laterally varying transmissivity.
- 11. The device of claim 10, wherein said transmissivity varies periodically in one lateral dimension.
- 12. The device of claim 1, wherein said grating is operative to reflect laterally uniform, polarized incident light with a predetermined, laterally varying reflectivity.
- 13. The device of claim 12, wherein said reflectivity varies periodically in one lateral dimension.
- 14. The device of claim 1, wherein said grating is operative to transform light incident thereon into a transmitted beam having a predetermined, laterally varying polarization state.
- 15. The device of claim 14, wherein said transmitted beam has an azimuthal angle that varies linearly in one lateral dimension.

- 16. The device of claim 14, wherein said transmitted beam is radially polarized.
  - 17. The device of claim 16, wherein said radial polarization is in-phase.
  - 18. The device of claim 16, wherein said radial polarization is anti-phase.
- 19. The device of claim 14, wherein said transmitted beam is azimuthally polarized.
- 20. The device of claim 19, wherein said azimuthal polarization is inphase.
- 21. The device of claim 19, wherein said azimuthal polarization is antiphase.
- 22. The device of claim 1, wherein said grating is operative to transform light incident thereon into a reflected beam having a predetermined, laterally varying polarization state.
- 23. The device of claim 22, wherein said reflected beam has an azimuthal angle that varies linearly in one lateral dimension.
- 24. The device of claim 22, wherein said reflected beam is radially polarized.

- 25. The device of claim 24, wherein said radial polarization is in-phase.
- 26. The device of claim 24, wherein said radial polarization is anti-phase.
- 27. The device of claim 22, wherein said reflected beam is azimuthally polarized.
- 28. The device of claim 27, wherein said azimuthal polarization is inphase.
- 29. The device of claim 27, wherein said azimuthal polarization is antiphase.
  - 30. A particle accelerator, comprising:
  - (a) a source of light;
  - (b) a first optical mechanism for forming said light into an annular beam;
  - (c) the device of claim 1, for imposing radial polarization on said annular beam;
  - (d) a second optical mechanism for focusing said radially polarized annular beam onto a focal region; and
  - (e) a particle source for directing a beam of the particles longitudinally through said focal region.
  - 31. A method of cutting a workpiece, comprising the steps of:
  - (a) providing a beam of light;



- (c) directing said radially polarized beam at the workpiece to cut the workpiece.
- 32. An apparatus for measuring a polarization state of light, comprising:
- (a) the device of claim 1; and
- (b) a mechanism for measuring a lateral variation of an intensity of the light after the light has been manipulated by the device of claim 1.
- 33. A method of modulating an intensity of laterally uniform, polarized light of at most a certain maximum wavelength, comprising the steps of:
  - (a) solving an equation

$$\nabla \times \vec{K}(K_0,\beta) = 0$$

for a grating vector  $\vec{K}$  that is defined by a wavenumber  $K_0$  and by a direction  $\beta$  relative to a reference direction, the modulation depending on  $\beta$ ,  $\vec{K}$  being such that at least a portion of a grating fabricated in accordance with  $\vec{K}$  has a local period less than the maximum wavelength of the light;

- (b) fabricating said grating in accordance with said grating vector  $\vec{K}$ ; and
- (c) directing the light at said grating.

- 34. The method of claim 33, wherein said fabricating is effected by forming said grating as electrically conducting stripes on a substrate.
- 35. The method of claim 34, wherein said substrate includes a material selected from the group consisting of gallium arsenide, zinc selenide, quartz and silica glass.
- 36. A method of imposing a polarization state having a predetermined, laterally varying azimuthal angle  $\psi$  on light of at most a certain maximum wavelength, comprising the steps of:
  - (a) solving an equation

$$\nabla \times \vec{K}(K_0, \beta) = 0$$

for a grating vector  $\vec{K}$  that is defined by a wavenumber  $K_0$  and by a direction  $\beta$  relative to a reference direction,  $\beta$  being related to  $\psi$  by  $\beta = \psi - \Delta \psi(K_0)$ ,  $\vec{K}$  being such that at least a portion of a grating fabricated in accordance with  $\vec{K}$  has a local period less than the maximum wavelength of the light;

- (b) fabricating said grating in accordance with  $\vec{K}$ ; and
- (c) directing the light at said grating.
- 37. The method of claim 36, wherein said reference direction is an x-direction of a Cartesian (x,y) coordinate system, so that  $K_0$  and  $\beta$  satisfy:

$$\frac{\partial K_0}{\partial y}\cos(\beta) - K_0\sin(\beta) \left[ \frac{\partial \psi}{\partial y} - \frac{\partial \Delta \psi}{\partial K_0} \frac{\partial K_0}{\partial y} \right] = \frac{\partial K_0}{\partial x}\sin(\beta) + K_0\cos(\beta) \left[ \frac{\partial \psi}{\partial x} - \frac{\partial \Delta \psi}{\partial K_0} \frac{\partial K_0}{\partial x} \right]$$

- 38. The method of claim 36, wherein said reference direction is a radial direction of a polar  $(r, \theta)$  coordinate system.
- 39. The method of claim 38, wherein said fabricating is effected by forming said grating as electrically conducting stripes on a substrate.
- 40. The method of claim 39, wherein said substrate includes a material selected from the group consisting of gallium arsenide, zinc selenide, quartz and silica glass.
- 41. A method of measuring a polarization state of light of at most a certain maximum wavelength, comprising the steps of:
  - (a) providing a grating having a transmission axis that varies in one lateral dimension, at least a portion of said grating having a local period less than the maximum wavelength of the light;
  - (b) directing the light at said grating;
  - (c) measuring an intensity of the light that has traversed said grating; and
  - (d) determining three Stokes parameters of the light from said intensity.
- 42. The method of claim 41, wherein said Stokes parameters are  $S_0$ ,  $S_1$  and  $S_2$ .

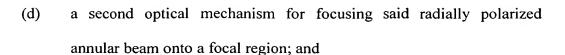
- 43. The method of claim 41, further comprising the step of:
- (e) causing at least a portion of the light to traverse a quarter wave plate before traversing said grating.
- 44. The method of claim 43, wherein said Stokes parameters are  $S_0$ ,  $S_1$  and  $S_3$ .
- 45. The method of claim 41, wherein said measurement is a near-field measurement.
- 46. The method of claim 41, wherein said transmission axis varies continuously in said one lateral dimension.
- 47. The method of claim 46, wherein said transmission axis varies linearly in said one lateral dimension.
- 48. The method of claim 41, wherein said grating is substantially planar and includes a plurality of electrically conducting stripes arranged so that said grating has a space-variant, continuous grating vector, said transmission axis being a direction of said grating vector.
- 49. The method of claim 41 wherein said Stokes parameters are determined by performing respective integral transforms of said intensity in said lateral dimension.



- 50. A method of measuring a polarization state of light of at most a certain maximum wavelength, comprising the steps of:
  - (a) providing a grating having a reflection axis that varies in one lateral dimension, at least a portion of said grating having a local period less than the maximum wavelength of the light;
  - (b) directing the light at said grating;
  - (c) measuring an intensity of the light that is reflected from said grating; and
  - (d) determining three Stokes parameters of the light from said intensity.
- 51. An optical device, for transforming an incident beam of light into a transformed beam of light, comprising:
  - (a) a substantially planar grating including a plurality of metal stripes and having a space-variant continuous grating vector, such that the transformed beam is substantially free of propagating orders higher than zero order.
- 52. The device of claim 51, wherein a magnitude of said grating vector varies laterally and continuously.
- 53. The device of claim 51, wherein a direction of said grating vector varies laterally and continuously.
  - 54. The device of claim 51, wherein said grating vector is periodic.

- 55. The device of claim 51, wherein said stripes include a metal.
- The device of claim 51, further comprising:
- (b) a substrate supporting said stripes.
- 57. The device of claim 51, wherein the transformed beam is a transmitted beam, and wherein said grating is operative to pass laterally uniform, polarized incident light with a predetermined, laterally varying transmissivity.
- 58. The device of claim 51, wherein the transformed beam is a reflected beam, and wherein said grating is operative to reflect laterally uniform, polarized incident light with a predetermined, laterally varying reflectivity.
- 59. The device of claim 51, wherein the transformed beam is a transmitted beam having a predetermined, laterally varying polarization state.
- 60. The device of claim 1, wherein the transformed beam is a reflected beam having a predetermined, laterally varying polarization state.
  - 61. A particle accelerator, comprising:
  - (a) a source of light;
  - (b) a first optical mechanism for forming said light into an annular beam;
  - (c) the device of claim 51, for imposing radial polarization on said annular beam;





(e) a particle source for directing a beam of the particles longitudinally through said focal region.

2

62. A method of cutting a workpiece, comprising the steps of:

- (a) providing a beam of light;
- (b) imposing radial polarization on said beam of light, using the device of claim 51, and
- (c) directing said radially polarized beam at the workpiece to cut the workpiece.
- 63. An apparatus for measuring a polarization state of light, comprising:
- (a) the device of claim 51; and
- (b) a mechanism for measuring a lateral variation of an intensity of the light after the light has been manipulated by the device of claim 1.
- 64. A method of transforming an incident beam of laterally uniform, polarized light into a transformed beam having a modulated intensity, comprising the steps of:
  - (a) solving an equation

$$\nabla \times \vec{K}(K_0,\beta) = 0$$

for a grating vector  $\vec{K}$  that is defined by a wavenumber  $K_0$  and by a direction  $\beta$  relative to a reference direction, the modulation depending on  $\beta$ ,  $\vec{K}$  being such that the transformed beam is substantially free of propagating orders higher than zero order;

- (b) fabricating said grating in accordance with said grating vector  $\vec{K}$ ; and
- (c) directing the incident beam at said grating.
- 65. A method of transforming an incident light beam into a transformed beam upon which is imposed a polarization state having a predetermined, laterally varying azimuthal angle  $\psi$ , comprising the steps of:
  - (a) solving an equation

$$\nabla \times \vec{K}(K_0,\beta) = 0$$

for a grating vector  $\vec{K}$  that is defined by a wavenumber  $K_0$  and by a direction  $\beta$  relative to a reference direction,  $\beta$  being related to  $\psi$  by  $\beta = \psi - \Delta \psi(K_0)$ ,  $\vec{K}$  being such that the transformed beam is substantially free of propagating orders higher than zero order;

- (b) fabricating said grating in accordance with  $\vec{K}$ ; and
- (c) directing the incident beam at said grating.
- 66. A method of measuring a polarization state of an incident light beam, comprising the steps of:

- (a) providing a grating having a transmission axis that varies in one lateral dimension, said grating being operative to transform the incident beam into a transformed beam that is substantially free of propagating orders higher than zero order;
- (b) directing the incident beam at said grating;
- (c) measuring an intensity of the transformed beam; and
- (d) determining three Stokes parameters of the light from said intensity.